

# Temporary extra-anatomic brain perfusion followed by total rerouting of the supra-aortic vessels for hybrid repair of a ruptured aortic arch aneurysm

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Hybrid repair of ruptured aortic arch repair has been proposed as a valuable approach. However, the presence of an anterior mediastinal hematoma must be carefully detected because of the inherent risk of rupture at sternotomy. We report the case of a patient presenting a ruptured aortic arch aneurysm with anterior rupture who underwent hybrid repair using a temporary extra-anatomic brain perfusion followed by total rerouting of the supra-aortic trunks. We propose this adjunctive technique as a means of allowing a safe endovascular exclusion of aortic arch lesions and avoiding the risk of acute and total aortic rupture in case of anterior rupture of aortic arch aneurysms. (*J Vasc Surg* 2011;54:1145-7.)

Conventional surgical repair of the aortic arch using cardiopulmonary bypass and deep hypothermic circulatory arrest still carries a substantial rate of mortality and morbidity, especially in emergent setting. The duration of circulatory arrest and brain perfusion during the arrest period are the most important factors affecting morbidity and mortality. However, it still represents the reference treatment for young and healthy patients.

Hybrid repair has been proposed as a valuable approach for high-risk patients. However, the presence of an anterior mediastinal hematoma must be carefully detected because of the inherent risk of rupture at sternotomy. Thus, a hybrid procedure could be precluded, and extramediastinal cannulation and deep hypothermia before sternal entry is suggested to avoid exposure to uncontrolled bleeding. However, in some situations, such as recent intracranial bleeding, cardiopulmonary bypass requiring major anticoagulation can be precluded.

We report the use of a temporary extra-anatomic brain perfusion allowing endovascular exclusion followed by total rerouting of the supra-aortic vessels for a ruptured aortic arch aneurysm with mediastinal hematoma underlying the sternum.

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Competition of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a competition of interest.

0741-5214/\$36.00

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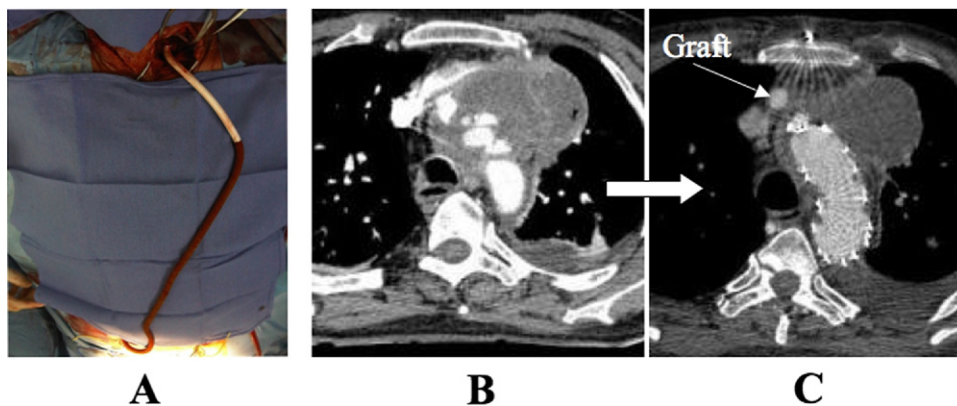
doi:10.1016/j.jvs.2011.03.271

## CASE REPORT

A 65-year-old man (Fig) with recent past history of intracerebral hematoma secondary to rupture of an anterior cerebral aneurysm (4 weeks ago) was referred to our institution for a severe retrosternal pain. An emergent computed tomography (CT) scan showed a 7 cm ruptured aortic arch aneurysm with a large anterior mediastinal hematoma. All the supra-aortic trunks were involved. Cardiopulmonary bypass with high dose heparinization was contraindicated because of his recent history of cerebral bleeding.

The whole arch needed to be stent grafted to achieve an effective exclusion of the aortic arch and, therefore, a total debranching of the supra-aortic trunks was required via a median sternotomy. However, the likelihood of complete rupture during sternal entry prompted us to achieve endovascular exclusion of the aortic arch rupture before supra-aortic debranching.

After moderate heparinization (0.5mg/kg), a temporary right femoral-to-left carotid artery bypass (which was laid on the body) was performed followed by a carotid-to-carotid crossover bypass. Angiography was performed through an angiographic catheter introduced retrogradely via the right common carotid. A Valiant (38 mm/200mm) thoracic stent-graft (Medtronic AVE, Santa Rosa, Calif) was deployed through a left femoral access in the aortic arch above to the brachiocephalic trunk (BT). Intraoperative angiography showed the correct placement of the stent graft with no residual endoleak and a good perfusion of the supra-aortic trunks via the femoral-carotid and carotid-carotid bypasses. Then, a median sternotomy was performed, disclosing a large anterior hemothorax without active bleeding, confirming the exclusion of aortic arch aneurysm. The ascending aorta was exposed and, after a partial clamping, a 10 mm Dacron graft was anastomosed. The distal portion of the graft was sutured to the BT (end-to-end anastomosis). Then, the BT, the left common carotid artery



**Fig. A**, Temporary femoro-bicarotid bypass in situ prior to commencement of the aortic arch exclusion. **B**, CT-scan showing a ruptured aortic arch aneurysm associated with anterior hemomediastinum. **C**, Postoperative CT scan confirming the patency of ascending aorta to carotid artery bypass and complete exclusion of the aortic arch aneurysm.

(LCCA), and the left subclavian artery were ligated in their proximal portion. The LCCA remained perfused by the carotid-to-carotid crossover bypass. The temporary femoral-carotid bypass was removed, leaving a cuff of Dacron as a patch at each anastomosis.

The patient was extubated on the first postoperative day. There were no cerebral, renal, or spinal complications. A left lung infection required a prolonged stay in the intensive care unit. A postoperative CT scan showed the effective exclusion of the lesion with no prosthetic or periprosthetic anomaly. Patient was discharged home on the 21st postoperative day. Twelve months after the procedure, the patient remained asymptomatic with no CT evidence of endoleak.

## DISCUSSION

Emergency aortic arch surgery is a major challenge due to the severity of the lesions, hypothermia, circulatory arrest, and long cardiopulmonary bypass time, conditioning postoperative bleeding and producing high mortality (up to 50% in high volume center<sup>1</sup>) and morbidity mainly owing to the adverse neurologic sequelae.

Endovascular management has emerged during the past decade as a valuable treatment modality for descending thoracic aortic diseases and was recently proposed for delicate anatomic regions such as the aortic arch. Recent reports<sup>2,3</sup> have demonstrated the technical feasibility of complete or partial debranching of the supra-aortic trunks associated with endovascular repair of the aortic arch. Patients with arch aneurysms that involve the portion of the arch adjacent to the brachiocephalic trunk require total aortic arch debranching through a median sternotomy to obtain an adequate proximal landing zone. An anterior mediastinal hematoma must be detected because of the inherent risk of an acute and total rupture at sternotomy. Thus, primary sternal approach should be ahead of an extrathoracic cannulation and deep hypothermia to avoid exposure to important bleeding. However, in some situations (such as active bleeding, significant thrombocytopenia, recent neurosurgery, intracranial bleeding, etc), cardiopulmonary bypass requiring major anticoagulation can be precluded.

Walterbusch et al<sup>4</sup> reported in 1984 a case of restoration of carotid blood flow by femorocarotid bypass in acute aortic dissection before ascending aorta reconstruction. In 2008, Schonholtz et al<sup>5</sup> described a percutaneous external shunt to restore carotid flow in a patient with acute type A aortic dissection and carotid occlusion. In this case, the use of a temporary femoro-bicarotid bypass allows thoracic stent graft placement and complete exclusion of the aortic rupture. Subsequently, after the uneventful sternal entry, a lasting revascularization with inflow from the proximal ascending aorta can be safely performed.

For non-ruptured aortic arch aneurysm, the risk of bleeding due to the intraoperative rupture of the aneurysm is very low. Therefore, it does not seem useful to propose the use of a temporary femoro-bicarotid bypass in all patients requiring aortic arch endografts. Furthermore, it would lengthen the debranching procedure.

In our experience,<sup>2</sup> for ruptured aneurysm without anterior mediastinal hematoma, sternal entry can be safely performed.

## CONCLUSION

Hybrid repair of ruptured aortic arch repair has been proposed as a valuable approach. However, the presence of an anterior mediastinal hematoma must be carefully detected because of the inherent risk of rupture at sternotomy. The use of a temporary femoro-bicarotid bypass allows stent graft placement and complete exclusion of the aortic rupture. Subsequently, after the uneventful sternal entry, a lasting revascularization with inflow from the proximal ascending aorta can be safely performed.

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Submitted Feb 1, 2011; accepted Mar 23, 2011.

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